A COMPARISON OF MUNICIPAL SOLID WASTE MANAGEMENT IN SELECTED LOCAL AUTHORITIES IN SRI LANKA

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Abstract

Solid waste has become a critical issue with rising population, urbanization, economic activities and consumerism, especially in urban centers creating a negative impact on environment due to inappropriate handling of municipal solid waste. Further, social, economical and health issues such as unpleasant odor, ground water contamination, epidemics and social effects also are being created due to land filling. Lack of physical, human and financial resources, poor participation and less enthusiasm among community groups and government representatives overloaded with additional work none related to solid waste activities are significant challenges.

Equally, literature revealed that existing SWM systems established within most local authorities are not properly operated and maintained in Sri Lanka. Hence, significant gaps are visible in solid waste management activities at local authorities. Thus, this research intends to explore municipal solid waste management systems in Sri Lanka to identify best practices.

Case study research approach was used and multiple cases were selected representing both best and worst practices in municipal solid waste management. Data were gathered through semi structured interviews. An outcome of the study is a framework developed for best practices of solid waste management which can be used at local authorities for effective and efficient municipal solid waste management.

Key words: municipal solid waste, municipal solid waste management, local authorities, best practices

1. Introduction

Solid waste, especially municipal solid waste (MSW) is a pressing problem in the world. This problem has become more severe over the last ten years due to rising populations and increasing waste generation rates resulting from increased consumption of a range of products (Amangabara et al., 2007). According to Business Dictionary (2009), MSW means all types of solid waste generated by household and commercial establishments and collected usually by local government bodies and includes residential, commercial, institutional and construction and demolition waste. According to the Eurostat regular publication (Eurostat, 2009), around 1,300 million tons of waste is being produced each year in the European Union, of which 260 million tons is municipal waste.

Municipal solid waste consists of all solid material that an urban society can no longer use economically and must be discarded in some way, so that it will not harm environment (Katugampola, 2002). Thus, municipal solid waste management (MSWM) is an integral part of urban environment and planning of urban infrastructure to ensure a safe and healthy human environment (Visvanathan and Trankler, 2003). Consequently, many countries have established several SWM strategies within their local authorities in order to mitigate health and environmental issues of municipal solid waste. Equally, MSW is a growing problem in urban areas of Sri Lanka and this problem is aggravated due to absence of proper solid waste management systems at local authorities (Central Environment Authority, 2005). According to Bandara and Hettiaratchi, (2010) MSW management (MSWM) status in Sri Lanka is unsystematic. There is no uniform framework within each Municipal Council, Urban Council and Pradesiya sabhas towards MSWM. Hence, most of systems are not operating. In this context, an urgent need arises to identify best practices of MSWM to streamline MSWM practices at local authorities. Thus, this study aims to explore municipal solid waste management systems of local authorities in Sri Lanka, to identify best practices of MSWM which can be considered in establishing an uniform MSWM system at local authorities in Sri Lanka. Next section of the paper presents a review on MSWM in general and in particular to Sri Lankan context.

2. Literature findings

2.1. Municipal solid waste management

Municipal solid waste management is a worldwide problem and it is becoming more and more complicated day by day due to rise in population, industrialization as well as changes in our life styles (singh et al., 2011) which becomes a responsibility of a local government. In the previous decade residential waste accounted for 55% to 65% of total MSW generation, while commercial waste generation was between 35%-45% (Popor et al., 2004). Urban areas in Asia produced approximately 0.76 million tons of municipal solid waste (MSW) per day in 1998, which is expected to rise to 1.8 million tons by 2025. China alone produced 0.14 billion tons of MSW in 1998 (Pokhrel and Viraraghavan, 2005). Along with rapid economic development and continuing population growth, conservation and protection of environment and public health, accomplishing effective and efficient

municipal solid waste management should be a priority for cities in developing countries (Marchand, 1998 cited Jin et al., 2006).

Handling and disposal of MSW is a growing concern as the volume of waste generated in developing countries continue to increase (Ogbonna, 2007). Kofoworola (2007) concluded that municipal solid waste management is organized and systematic channeling of waste through pathways to ensure that they are disposed of with attention to acceptable public health and environmental safeguards. However, proper management cannot be achieved without a well-designed waste management plan. MSWM is to protect the health of a population, promote environmental quality, develop sustainability, and provide support to economic productivity (Rotich et al., 2006). Improper MSWM causes many types of pollution, including air, soil, and water pollution (Ming, 2011). Environmental management centre (2007) further alluded that without an effective and efficient solid-waste management system, waste generated from various human activities can cause health hazards and has a negative impact on the environment. In particular, MSWM is a strategic issue that is restricted by resource needs, realistic resource support, team requirements and conformity with expected outcomes, among others (Vego et al., 2008). Accordingly, literature emphasized the importance of proper MSWM system to face challenges arising due to increasing populations and waste generation.

2.2. Municipal solid waste management in Sri Lanka

MSW is a growing problem in urban areas of Sri Lanka and this problem is aggravated due to absence of proper solid waste management systems at local authorities (Central Environment Authority, 2005). A study conducted by Perera (2003) indicated that approximately 80-85% of municipal domestic solid waste produced in Sri Lanka consists of organic waste, including food and garden waste. The balance, 15%-20% consists of paper, plastics, glass, metals and other inorganic materials.

MSW in Sri Lanka has a high content of organic matter, moderate contents of plastics and paper and low content of metal and glass. It has a high moisture content (70–80% on a wet mass basis) and low calorific value (about 600– 1000 kcal/kg) (de Alwis, 2000). Further**,** it has been revealed that 50% of local authorities collect less than 2 tons of waste per day and 24% of households in Southern Province of Sri Lanka have access to waste collection systems (Vidanaarachchi et al., 2006).

A study by UNEP (2001 cited Vidanaarachchi et al., 2006) showed that the best estimate of total municipal waste generation in Sri Lanka is around 6400 tons/day. A recent study conducted by Vidanaarachchi et al. (2006) mentioned that urban population in Sri Lanka is 22% and estimated municipal solid waste generation was 0.89kg/cap/day in 1999. Vidanaarachchi et al. (2006) further predicted that the country would have a municipal solid waste generation rate of 1.0kg/cap/day, and an urban population of 42.6% of the total population by 2025.

Disposal of solid waste is a major environmental problem in Sri Lanka at present and has become a national issue. National Action Plan of Sri Lanka has identified hazard solid waste disposal to be a major cause of environmental degradation (Bandara and Hettiaratchi, 2010). There are many solid waste management projects conducted under the guidance of Waste Management Authority of Sri Lanka, such as large scale composting projects, electricity generation by waste, large scale land filling

under "*pilisaru*" national project and medium scale waste management projects (Mannapperuma, 2008). However, lack of community participation in waste management and other programmes impact on success of these projects. Thus, public awareness programmes, promotion of waste segregation by public at generation points, establishment of "Sampath piyasa" centres to accumulate waste from collection points and storages to store waste until disposal have been initiated by the government. Next section presents the research methodology adopted to explore MSW practices in Sri Lanka.

3. Research Methodology

Case study was selected as the research approach as it provides opportunity for in–depth analysis of existing municipal solid waste management practices to identify gaps. Yin (2009) mentioned that case study can be applied to explain presumed casual links in real life interventions which are too complex for a survey or experimental methods. Four local authorities were selected as cases. Two cases were selected as best management practices and other two cases were selected as weak management practices based on perceptions about them among local authorities associated with SWM service.

Semi-structured interviews were conducted to gather data as it facilitated in depth analysis and gather different views and opinions of respondents within scope of study. Table 1 illustrates profiles of selected interviewees for these case studies.

Table 1: Profiles of interviewees

Cases	*Types of local authority*	*Agent*	*Designation*
Case A	*Municipal council*	*A1*	*Chief Public Health Inspector*
		A2	*Public Health Inspector*
		A3	*Project Development Officer*
Case B	*Municipal council*	*B1*	*Public Health Inspector*
		B2	*Environmental Development Officer*
Case C	*Municipal council*	*C1*	*Chief Municipal Engineer*
Case D	*Municipal council*	*D1*	*Chief Municipal Engineer*
		D2	*Chief Medical Officer of Health*
		D3	*Public Health Inspector*

Content analysis was used to analyze collected data. Content analysis is a method that compresses many words into a fewer content categories. According to Silverman (2006) this involves establishing categories and then counting number of instances that fall into each category. This method pays particular attention to reliability of its measures and to validity of its findings. Nvivo software was used for easier and speedy content analysis. Relevant coding structures were prepared using software and analyzed in order to determine gaps in municipal solid waste management.

4. Case findings

Findings are presented on eight areas as given below.

4.1. Institutional arrangements

Empirical finding showed that local authorities' institutional arrangement differ, though institutional arrangement is more important in carrying out an effective municipal solid waste management process within a locality. There is no unique management structure related to municipal solid waste management at local level.

Case B has been sub-divided into seven Council Wards, with a Public Health Inspector responsible for MSWM process in each ward. Environment Development Officer's support was important for implementation of development programmes of SWM and maintaining day to day documentary activities related to SWM processes. However, many cases revealed that there is no responsible person for MSWM when Municipal Engineer or MOH are in charge, who generally has more duties than MSWM practices. Thus, they dedicate less time for MSWM processes.

4.2. Capacity building

According to observed findings, local authorities have used several strategies to create awareness among workers and public of a locality. Institutions A and B have satisfactory levels of capacity building. Institutions A and B have conducted awareness programmes for workers of the council, school children and public and implemented training programmes for council staff. Further, institution A has introduced national competency standards for "Municipal Solid Waste Operation Assistants" and contributed to the development of programme by motivating and improving efficiency of cleaning workers. Also, institutions A and B are targeting to change the minds of future generations.

Interviewees' said that unskilled workers and lack of resources restrict efficiency of SWM activities and recruitment of workers is time consuming, affecting capacity building. Institutions C and D, do not perform activities to enhance capacities of those institutions.

4.3. Policy and regulatory framework

National policy on MSWM is applicable to local authorities. Institution A introduced new policies such as regulations to separate different wastes at source level and fines for not adhering to such practices and imposed a tax in early 2010 on selected main generators of waste, such as restaurants, tea boutiques, markets, etc.

However, institutions C and D has less capability in regulation changes and developments due to high political interference when introducing new policies.

4.4. Financial aspects

As empirical findings revealed, MSW management services account for a high percentage of municipal budgets. Institution A is satisfactorily recovering expenditure through selling compost fertilizers, recyclable items and collecting taxes and fines. Further, public awareness strategies are conducted to minimize per person costs on municipal solid waste management. Institution B has new income routes related to MSWM activities, using limited resources. But they lack adequate funds for purchase of equipment and spare parts causing delays in repair and maintenance work of equipment and thus, further inefficiencies. At institution C, there is no revenue activities related to MSWM processes due to poor coordination with government or any other funding bodies.

4.5. Municipal Solid Waste Generation

Empirical findings showed that classification and identification of MSW types and generation sources provides a base for development of appropriate MSW management practices. Institutions A and B have classified MSW according to sources of generation and types. Main source of solid waste generation are residences, schools and markets. Material composition of generated solid waste is classified into such types as organic waste, paper and cardboard, polythene and plastic, glass and metals. Institution B maintains daily records on generation of MSW and their composition. Agent D1 – Municipal Engineer said that "We do not have any records related to generation of MSW and do not much consider to identify or classify generation of waste. But if there are any details about generation of MSW it can be used to plan and implement MSWM strategies."

4.6. Municipal solid waste reduction

As source reduction actually prevents generation of waste in the first place, it is the most preferred method of waste management and goes a long way towards protecting environment and reducing costs. Many local authorities have tried to minimize generation of MSW by implementing many programmes. Institution A implemented 3R initiative programmes introducing new policies, establishing 3R committees, recycling/ collecting centers and conducting awareness programmes for school children. Institution B introduced several different composting methods including Barrel System, Pit System and Bio Composting System "jeeva kotuwa" which are used at household level.

Similarly, under the Sustainable Cities Programme, institution D has taken many small scale initiatives to introduce non-conventional methods of waste reduction such as home bio gas plants, home composting plants and establishing recyclable items collecting centers. It has already distributed compost-bins and household compost production has been identified as an option to enhance economic conditions of urban poor people through selling of compost and/or home gardening. However, institution C is providing less interest on waste reduction and they have already faced several issues related to MSW such as more expenditure on waste handling, in adequate land spaces for disposal and increasing public complaints.

4.7. Municipal solid waste collection and transport

According to empirical findings, public participation and involvement is very important for an efficient collection system. Most local authorities have satisfactory MSW collection and transportation procedures because if there is any failure in collection and transportation there will be more complaints against them. Institutions A and B have introduced door to door collection system replacing the street bin collection system to reduce environmental effects. Further, collection vehicles were fitted with musical horns which are loud and clearly audible to households on streets in advance before they reach their premises and use compartmentalized vehicles for collection of segregated waste while collection through handcarts is offered to areas not easily accessible by larger vehicles.

At institution D, waste from households and commercial premises is primarily collected through community collection bins. Those bins are not used by many. Though there is a time schedule for collecting the waste from residential and market places it is constantly changed due to lack of labour recourses and insufficient vehicles.

4.8. Municipal solid waste treatment and disposal

According to empirical findings, local authorities have strategies on treatment and disposal of MSW. Institutions A and B have successful treatment and disposal processes. Institution A has success with fertilizer composting plant that operates at full capacity due to high demand for fertilizers. After operating this plant they reduced their disposal amounts of bio degradable waste from 70% to 20%. Institution B also has operated composting plants. However, they have no waste segregation system that is implemented prior to reaching the treatment site.

Institution D has no procedure on treatment of MSW due to lack of land space to establish new plants. At institution C, MSW is totally disposed to uncontrolled landfill sites which spread odor during rainy days, raising public complaints. Therefore, they are trying to convert it into a sanitary landfill site.

5. Discussion

Table: 2 indicates summary of findings of cross-case analysis and issues in MSWM systems.

Table 2: Summary of issues in case study approach

Key element	*issues*
Institutional arrangement	▪ *Poor coordination among local authorities and community.* ▪ *Poor coordination among internal divisions.* ▪ *Lack of expert or professional person responsible for SWM.*
Capacity building and awareness	▪ *Poor public participation at awareness programmes.*

	▪ *Officers not interested in participating at training programmes.* ▪ *Local authorities and public not aware about NSWM policies.* ▪ *Lack of experts/ professionals to conduct awareness programmes.*
Policy and regulatory framework	▪ *New regulations issued by local authorities at their own decision.* ▪ *No public hearing, when making new regulations.*
Financial aspects	▪ *Inadequate financial capacity for investments in new projects.* ▪ *Not familiar with new technologies.*
Waste generation and reduction	▪ *Not classifying generated waste according to types and sources.* ▪ *Poor record keeping related to generated MSW.* ▪ *Poor coordination among local authorities and community.*
Waste collection and transport	▪ *Lack of labour skills.* ▪ *Lack of expertise related to SWM.* ▪ *Public are not familiar with changes in SWM processes.* ▪ *Insufficient labor and other resources.*
Waste treatment and disposal	▪ *Workers/ officers not familiar with new technologies.* ▪ *No direct guidance to workers.* ▪ *Poor partnership with workers and public.* ▪ *Public are less aware about importance of waste recycling.* ▪ *Lack of financial capacity.*

Local authorities face many issues due to less consideration about institutional arrangements, financial aspects, waste generation and reduction stages, waste collection and transportation processes and waste treatment processes.

Table: 3 indicates summary of best practices suggested for MSWM systems, which emerged from case analyzing and literature review.

Table 3: proposed best practices

Key element	*Proposed best practices*
Institutional arrangement	▪ *Better coordination among local authorities and community.* ▪ *Appointment of experts or professionals exclusively responsible for MSWM services.*
Capacity building and awareness	▪ *Conduct awareness and training programmes.* ▪ *Implement awareness programmes and field visits for school children.* ▪ *Designate new names acceptable to society for certain positions such as "SWM Operation Assistant" instead of "Sanitary Labour".*

Policy and regulatory framework	▪ *Obtain public suggestions before introducing new regulations.* ▪ *Implement awareness programmes on new policies.*
Financial aspects	▪ *Find new income generating SWM activities.* ▪ *Find suitable recyclable item collectors from competitive bidding.* ▪ *Engage with NGO or government projects.*
Waste generation and reduction	▪ *Identify main waste generation sources and compositions.* ▪ *Introduce 3R approaches.* ▪ *Introduce sustainability programmes.* ▪ *Start recyclable items collecting centers and introduce 3R point card system.* ▪ *Began 3R committees through the locality.*
Waste collection and transport	▪ *Introduce door to door collection system.* ▪ *Create awareness among public about waste collection time schedules.* ▪ *Introduce horn bell collection system.* ▪ *Use compartmentalized vehicles.* ▪ *Use handcarts to reach places inaccessible by larger vehicles.*
Waste treatment and disposal	▪ *Waste segregation to be done at the source.* ▪ *Produce compost fertilizer.* ▪ *Maintain control over landfill sites.* ▪ *Acquire new technologies.*

6. Conclusion

Municipal solid waste becomes a global challenge due to limited resources, an exponentially increasing population, rapid urbanization and worldwide industrialization. In developing countries such as Sri Lanka, these factors are further affected by inadequate financial resources, inadequate management and technical skills within municipalities and government authorities. Though many local authorities attempt to avoid these drawbacks, environmental, social and health impacts are still visible due to poor waste management practices. Thus, this is a researchable problem to further investigate to identify gaps existing in municipal solid waste management practices.

The aim was achieved through in depth investigation of selected four local authorities. As indicated by case study findings, workers training and awareness programmes, staff training programmes and awareness programmes for public and school children with incentives were identified as existing best practices that enhance their capacities, while introducing new policies to improve the knowledge of public on waste segregation at source and reduction of waste generation. Certain local authorities are

engaged with NSWM policy to implement proper SWM practices within their localities, though few local authorities refrain from implementing new policies due to political interferences.

According to empirical findings, financial aspects are a key element of MSWM processes. Sale of recyclable items and composting fertilizer, taxes and fines are identified as existing incomes.

Further, classification of generated solid waste composition and identification of solid waste generation sources are important to plan and monitoring of MSWM practices at local authorities. Starting of recyclable items collection centers, encouraging home composting and home gardening, introducing home bio gas plants, conducting 3R initiative programmes and awareness programmes to encourage minimization of waste generation are feasible approaches to achieve MSW reduction. Poor coordination among communities and local authorities, unskilled workers, lack of technologies and resources are major issues which negatively affect many areas of MSWM processes at waste collection, storage, treatment and disposal.

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